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FISHERIES AND ENVIRONMENT CANADA

Government  
Publications

*Estuary Working Group*

B R I T I S H

C O L U M B I A

# INDEX

## SPECIAL ESTUARY SERIES

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**FISHERIES AND ENVIRONMENT CANADA**

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**INDEX**  
**SPECIAL ESTUARY SERIES**  
**VOLUMES 1-6**

**ESTUARY WORKING GROUP**  
**DEPARTMENT OF FISHERIES AND THE ENVIRONMENT**  
**REGIONAL BOARD PACIFIC REGION**

**By**  
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**Under the Direction of Dr. M. Waldichuk**

**Fisheries and Marine Service**

**Pacific Environment Institute**

**West Vancouver, B.C.**

**MARCH 1, 1979**

**\* Deceased March 15, 1978.**

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This INDEX concludes the review of work on 7 of the estuaries of British Columbia commenced in 1974. It was decided during the early 1970's by the Estuary Working Group of the Regional Board of the Pacific Region of the Federal Department of Fisheries and the Environment to collate and summarize all the environmental work that has been conducted on 18 "critical" estuaries of the province. The selected estuaries consist of the Fraser, Squamish, Skeena, Kitimat, Indian, Homathko, Wannock and Bella Coola on the British Columbia mainland coast and the Cowichan, Chemainus, Nanaimo, Campbell, Courtenay, Somass, Quatse, Salmon, Gold and Nimpkish on Vancouver Island. They were chosen on the basis of living resource potential and threat from development. Their locations are shown on the cover of this volume. The Special Estuary Series, the first 6 volumes of which are indexed here for authors and subject matter, have been comparatively widely distributed in major academic libraries of the province, as well as in reference holdings of governmental, educational and private environmental establishments.

When this INDEX was initiated in 1976, Dr. Neal M. Carter was contracted to do the work. Unfortunately, he was unable to continue after indexing the first volume in the Series. However, he was able to guide Adelle J. Leaney in carrying on the indexing of further volumes.

Dr. Carter was well qualified to index scientific works. He had had a brilliant scientific career following the acquisition of his Ph.D. in Biochemistry at McGill University, with: a post-doctoral fellowship in Germany; several years at the Pacific Biological Station in Nanaimo, conducting the first oceanographic work on the Pacific Coast of Canada, including the earliest publications on fjords of British Columbia; Director of the Pacific Fisheries Experimental Station of the Fisheries Research Board in Prince Rupert, and later in Vancouver; and finally, Associate Editor of the Journal of the Fisheries Research Board of Canada. He also edited for many years the Fisheries Research Board's Progress Reports of the Pacific Coast Stations, which were designed to inform fishermen and interested lay persons on current research work in fisheries. Following retirement in 1962, Dr. Carter continued assisting the Office of the Editor of the Fisheries Research Board in Ottawa with

indexing of its various publications. He was responsible for two index volumes, "Index and List of Titles, Fisheries Research Board of Canada and Associated Publications, 1900-1964", and the follow-up one for 1965-1972, which brought together all work of the Fisheries Research Board and its earlier counterparts from 1900 to 1972. He provided annual indexes for the Journal of the Fisheries Research Board after 1972 until 1977, when finally at the age of 75 he felt it was time he retired from indexing.

Dr. Neal M. Carter was also a very avid mountaineer. From his student days as an active participant in the Varsity Outdoor Club in the University of British Columbia through his many years as a member of the B.C. Mountaineering Club and the Alpine Club of Canada, Dr. Carter climbed many mountains in western Canada. He did this in part for recreation, but true to his character, he felt that something more tangible than recreation should be derived from these alpine pursuits. Accordingly, he always carried basic survey instruments on these expeditions to enable him to conduct some mapping. His early engineering training helped in this regard. Dr. Carter was also credited with carrying out some of the earliest photogrammetric surveying of B.C.'s coastal mountains. For his contributions to mountain exploration, Dr. Carter was made an Honorary Life Member of the Alpine Club of Canada.

Dr. Neal Marshall Carter passed away after an active and productive career on March 15, 1978, while vacationing in the Caribbean and engaging in some recreational diving among coral reefs. He will be long remembered not only for his contributions to science and to mountaineering, but also for his friendly nature and his remarkable ability to provide encouragement in counselling people, particularly students and young scientists, on many matters. We owe him a great deal for fostering scientific research in the marine environment and in fisheries on the Pacific Coast of Canada. It is a pleasure to acknowledge his enthusiastic participation in the preparation of this INDEX, one of the last technical projects in which he was involved.

M. Waldichuk

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## INTRODUCTION TO SPECIAL ESTUARY SERIES INDEX

SYMBOLS

The symbols listed below indicate the following:

- 3:        designates volume from which information cited (see page iv)
- : 48     designates page on which information is cited
- :IBO:    means mentioned *In Bibliography Only*
- :(344)   indicates a bibliographic reference source

EXAMPLES

- 5: 76, 77, 80(257) referenced information located in *Volume 5*, on pages 76, 77 and 80 and referenced in the *bibliography* of that volume on page 257.
- 1:213, 239(475, 479); 2:IBO:(329, 333, 334) relevant information cited in *Volume 1* on pages 213 and 239, and referenced in *bibliography* of that volume on pages 475 and 479. Additional source information may be found in the *bibliography* of *Volume 2* on pages 329, 333 and 334.

NOTE

- 1 - "re" is often used in the index references to imply "in relation to", etc.
- 2 - All authors mentioned in the Special Estuary Series are indexed. However, it should be noted, that in the present index the primary author has not been specified.
- 3 - During preparation of the Index, errors in the spelling of some names mentioned in Special Estuary Series volumes have been noticed. The authors of this Index have attempted to correct these wherever possible.
  - P. 1    Abbott-Smith, K.B.    instead of    Abbot-Smith, as in text.
  - P.14    Aro, K.V.                instead of    Aro, K.U., as in text.
  - P.27    Blackbourn, D.J.        instead of    Blackbourne, D.J., as in text.
  - Blackbourn, J.        instead of    Blackbourne, J., as in text.
  - P.44    *Sambucus*                instead of    *Sambaccus*, as in text 6:201.
  - P.54    *Cirsium*                 instead of    *Cirscium*, as in text 1:281.
- 4 - Organisms are listed alphabetically by genus and then by the specific name. Common names, when given, refer the reader to the scientific names.



### SPECIAL ESTUARY SERIES

- No. 1 The Fraser River Estuary Status of Environmental Knowledge to 1974.
- No. 2 The Squamish River Estuary Status of Environmental Knowledge to 1974.
- No. 3 The Skeena River Estuary Status of Environmental Knowledge to 1975.
- No. 4 The Cowichan-Chemainus River Estuaries Status of Environmental Knowledge to 1975.
- No. 5 The Nanaimo River Estuary Status of Environmental Knowledge to 1976.
- No. 6 The Kitimat River Estuary Status of Environmental Knowledge to 1976.

### ACKNOWLEDGEMENT

We thank Rose Dawson and Colleen Yuen for their painstaking efforts in typing, proof-reading and correcting this Index prior to its printing.

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- 1:IBO:(343-488); 2:IBO:(245-340); 3:IBO:(295-340);  
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- 3:IBO:(344) (maternal influences on the age at maturity of sockeye salmon)  
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 :(345) (age, sex & size composition of B.C. sockeye salmon catches)  
 :(345) (scale characteristics of sockeye salmon originating in small nursery areas of the system)

Bindweed (*see* *Polygonum convolvulus*)

## Biocon Research Limited

- 6:173 (information source)

Biodegradation (*see also* Oxygen, dissolved)

- 2:213-214 (in landfill from waste material)

Biological Oxygen Demand (*see* Oxygen, dissolved)Biology (*see also* subject headings relating to those below; types & names of organisms; topics related to; Land use; Pollution headings; Water quality)

- 1: 80-93; 2: 66-78; 3: 64-75; 4: 71-79; 5: 68-72; 6:65-74 (benthos & terrestrial invertebrates)  
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 : 97-100; 2: 82-83; 3: 77-78; 4: 79-80; 5: 72-74; 6: 74-76 (invertebrate fisheries resource)  
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- European white (*see* *Betula alba*)  
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## Birch, L.

- 1:IBO:(456) (soil classification for recreational capability in Boundary Bay)

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## Cowichan-Chemainus River Estuaries

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2:IBO:(284) (three quantitative benthic investigations re locality, environmental data, biomass, major taxon rank & species composition)  
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- 4:IBO:(279) (water quality assessment & recommendations on routine monitoring)  
:(286) (quantitative benthic investigations in the Strait of Georgia)  
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- Elymus hirsutus* (hairy ryegrass)  
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- 1:IBO:(459) (limitations & attractions of B.C. for industry)

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## Endersby, S.A.

- 6: 5(253) (Captain Vancouver's estuarine survey)
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- :112(275) (evaluation of physical & development planning for Kitimat)

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- 3:105 (location; abundance)
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## Endowment Lands (University of British Columbia) Park Committee

- 1:IBO:(459) (enviability of this unspoiled recreational area)

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- 1:IBO:(486) (map of principal B.C. power generating developments & main electric transmission system)

## Energy Hierarchy

- 1:220 (diagram re food chain)

## Energy Study Group

- 3:IBO:(347) (fish; power studies in the Yukon & northern B.C.)

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## Engineering Drillers Limited

- 1:IBO:(359) (Richmond Municipality soil report)

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- 2:201; 3:216 (in species list)
- 3: 88 (estuarine resident)

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- :136(322) (effects of development on estuary)
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- 1: 1 (definition & ecological importance of an)
- : 2 (area of Fraser River estuarine influence)
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- 1: ix, x; 2:xxi, xvi (formation & purpose)
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*Eteone longa* (class: Polychaeta; family: Phyllodocidae)

- 2: 70 (dominate in central delta, lower zone)
- :188; 3:199; 4:191 (in species list)

*Eteone pacifica* (polychaete)

- 3:199 (in species list)

*Eteone spetsbergensis* (polychaete)

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## Ettershank, G.

- 2:IBO:(256) (map; Woodfibre to Squamish)

*Eualus berkeleyorum* (Caridean shrimp)

- 1:IBO:(399); 2:IBO:(283); 3:IBO:(336) (B.C. records)

*Eucalanus* (calanoids; copepods)

- 1:272 (*E. bungii* (in species list))

*Eucampia* (diatoms)

- 1:290 (*E. zoodiacus* (in species list))
- 4:106 (re Chemainus Bay phytoplankton)

*Euchaeta japonica* (calanoids; copepod)

- 1:272; 2:198 (in species list)
- 5:IBO:(251) (life history; post embryonic development)

*Eucrangonyx gracilis* (amphipod)

- 4:188 (in species list)

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- 3:200 (*E. sp.* (in species list))
- 4:192 (*E. gigantea* (in species list))

*Euglenoids*

- 2:100 (estuarine phytoplankton components)
- :205; 3:219 (in species list)

*Eulachon* (*see Thaleichthys pacificus*)*Eulalia bilineata* (polychaete)

- 3:199; 4:191 (in species list)

*Eulalia nigrimaculata* (errant polychaete)

- 4:191 (in species list)

*Eulalia sanguinea* (errant polychaete)

- 4:191 (in species list)

*Eulalia sp.* (polychaeta, unspecified)

- 3:199 (in species list)

*Eulalia viridis* (errant polychaete)

- 4:191 (in species list)

*Eumetopias jubata* (sea lion)

- 1:IBO:(450); 2:IBO:(318); 3:IBO:(377) (general information)
- : (453); 2:IBO:(320) (distribution; food)
- : (499); 2:IBO:(318) (investigations)
- 2:126 (theoretical inhabitant)
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- 4:125 (frequency of occurrence)
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- 3: 88 (estuarine resident)
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- 1:314 (habitat; food; etc.)
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- 1:314 (habitat; food; etc.)
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## Eurocan Pulp and Paper Company Limited

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- 2: 89(295) (average annual steelhead & salmon escapement 1962-1971)
- : 89(295) (other fish records for river system; table)
- : 90(295) (fall & spring adult & juvenile migrations)
- 3:214(348) (Skeena River anadromous fish escapement)

## Fisheries Association of British Columbia

- 1:IBO:(414) (fisheries problems re proposed Fraser River Moran Dam)

## Fisheries Development Council

- 1:IBO:(476) (summaries of fisheries research re pollution problem)

## Fisheries Operations Directorate

- 2:145 (330) (logging practices re environmental influence)
- 3:IBO:(389) (B.C. Forest Service guidelines for clearcut logging; stream bank, shoreline & water quality protection)

## Fisheries Research Board of Canada

- 1:IBO:(414) (list of Nanaimo Station Circulars & Technical Reports)

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- :125 (assignment of dollar value, for salmon)
- :189 (suggested development of access, parking facilities, etc. re use of sandbars & rivers)
- :IBO:(423); 2:IBO:(300); 3:IBO:(357, 359); 4:IBO:(295) (value to B.C.)
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- 3: 95, 96, 97 (increased interest, development of tourism, suitability of Skeena River system, important species, effort involved, days spent, residential status, citizenship, nature of employment, species sought, money spent, revenue generated & jobs available re, upper regions of river)
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- 1:259 (in species list)

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## Fjarlie, L.R.I.

- 1: 70(383) (aerial photography in tracing Fraser River plume)
- :IBO:(383, 389, 476) (the Vancouver sewage problem)

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- yellow (*see Iris pseudacorus*)

Flag Rockfish (*see Sebastes rubrivinctus*)Flamingos (*see* Phoenicopteridae)

## Flannery, R.D.

- 1:IBO:(365) (soil survey of Whatcom County, Washington)

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- : 92-93 (benthic populations of Iona Island)
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- compound (*see Erigeron canadensis*)
- (*see Erigeron compositus*)

## Fleas

- water (*see* Cladocera)

## Flemer, D.A.

- 4:IBO:(283) (role of organic debris & associated micro-organisms in pelagic estuarine food chains)

## Fletcher, H.F.

- 1:IBO:(360) (phosphorus estimation, fixation & release in lower Fraser River valley soils)

## Fletcher, K.

- 1:IBO:(360) (cation distribution in Fraser River flats)
- : (480); 2:IBO:(334) (heavy-metal content of some B.C. freshwater fishes)

## Fletcher, R.H.

- 6:154(282) (powers of Kitimat Municipal Act)
- :155(282) (re ambient air quality monitoring program)
- :163(282) (dispersion of Eurocan pulp mill emission)

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- 1:278 (*F. sp.* (in species list))

## Flicker

- boreal (*see Colaptes auratus borealis*)
- common (*see Colaptes auratus*)



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- black (*see* Simuliidae)
- blow (*see* Calliphoridae)
- caddis (*see* Trichoptera)
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- danse (*see* Empididae)
- flower (*see* Syrphidae)
- horse (*see* Tabanidae)
- may (*see* Ephemeroptera)
- sand (*see* Psychodidae)
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## Flint, R.F.

- 4:IBO:(268) (glacial & Pleistocene geology)

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- :(431, 432); 2:IBO:(305, 306); 4:IBO:(297) (of southern B.C.)
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- :106 (true grasses; flowering plants; intertidally associated plants; arrow grass; cat-tail)
- :107 (location & factors affecting delta zone plant growth; location & precipitation re forest regions, zones & subzones)
- :108 (zonal & subzonal indicator species of Pacific coastal mesothermal forest region)
- :145 (streamside vegetation removal)
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- :IBO:(309) (re Saanich Peninsula)
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- :IBO:(267); 5:IBO:(225) (Vancouver Island Cretaceous species)
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*Florometra serratissima*

- 2:194 (in species list)

## Flounder

- arrowtooth (*see* *Atheresthes stomias*)
- starry (*see* *Platichthys stellatus*)

Flow (*see* Hydraulic models; Hydrology; Runoff; Sediments)Flowering Quillwort (*see* *Lilaea scilloides*)Flowering or Western Dogwood (*see* *Cornus nuttallii*)

## Floyd, P.D.

- 4:IBO:(307) (southeastern Vancouver Island human geography)

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- 1:250 (atmospheric pollution from metallurgical plants)
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- alder (*see Empidonax traillii alnorum*)
- dusky (*see Empidonax oberholseri*)
- gray (*see Empidonax wrightii*)
- Hammond's (*see Empidonax hammondi*)
- least (*see Empidonax minimus*)
- olive-sided (*see Nuttallornis borealis*)
- Traill's or willow (*see Empidonax traillii*)
- western (*see Empidonax difficilis*)
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## Flynn, L.L.

- 3:IBO:(312) (oceanographic studies; marine & terrestrial geology of Skeena River delta & estuary & Chatham Sound)

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- :180 (estuary an important link)

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- 2:IBO:(331) (waste treatment modifications at Squamish, B.C.; unpublished report)

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## Foerster, R.E.

- 1:107, 108(414, 415) (various reports on Fraser River sockeye salmon spawning & migrations)
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- 3: 80(348) (spawning season; emergence; subsequent migration)
- :IBO:(346) (B.C. Pacific salmon migration)
- 4: 98(293) (pilchards; American shad)
- :IBO:(293) (Cowichan Bay salmon mortality)
- 5:IBO:(251) (hydromedusae of the Vancouver Island region)

## Fofonoff, N.P.

- 3:IBO:(323) (stilling well design using analogue computer technique)
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## Folliculina expansa (protozoa)

- 4:189 (in species list)

## Fomes (bracket fungi)

- 1:278 (*F. sp.* (in species list))

## Fontinalis antipyretica (water moss)

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- 3:224 (in species list)

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- 1:319-323 (table of, by mammalian species on estuary)

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- :251; 2:IBO:(329) (contributing to air pollution)

## Footit, R.G.

- 1:304, 318(441) (Franklin's gull in Fraser River delta)
- 2:IBO:(312) (Franklin's gull in B.C.)

Forage (*see also* Agriculture; Animal (farm)

- production; Farming; Food and feeding habits)
- 1:135 (types of crops)

## Foraminiferida

- 1: 80, 81 (variation in amount, in Strait of Georgia to Fraser River delta)
- :258; 4:189; 5:166; 6:188 (in species list)
- :IBO:(399) (Juan de Fuca Strait & Strait of Georgia distributions)
- 3:IBO:(306) (of Hecate Strait, Queen Charlotte Sound & Vancouver Island shelf regions)
- : (313); 6:IBO:(257, 258) (re glaciation)
- : (337) (of Dixon Entrance)
- 4: 71 (consumed by trout)
- : 76 (Stuart Channel abundance & habitat)
- :IBO:(270); 5:IBO:(229) (Vancouver Island Upper Cretaceous zones)
- 6: 71 (Kitimat Arm habitats)

## Forb Areas

- 1:129-131 (grass & forb community of delta & estuary)
- :130 (map of major, in delta & estuary)
- :135 (of dykes & jetties)
- 3:114 (in Skeena estuary)

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- 1:127, 142, 145, 181(430, 460) (floral surveys of Fraser River delta)
- :129(431) (shrubs & grasses of delta)
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## Foreman, R.E.

- 1:147, 148(434); 5:IBO:(263) (Fraser River delta macrophytes)
- 4:106(297); 5:IBO:(262) (macrophytic algae research in Strait of Georgia)
- :IBO:(286) (green urchin (*Strongylocentrotus droebachiensis*) distribution & abundance in Strait of Georgia)
- 5: 93(262) (macrophytic algae of Nanaimo estuary)
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- :179(262) (intertidal algal species list)
- :IBO:(262) (new B.C. marine algal records)

## Fore-slope Off Estuary

- 1: 26-29 (sediment deposition sources; rate; angle of)

## Forest Soil Committee of the Douglas-fir Region

- 1:IBO:(432) (introduction to soils in Pacific northwest region)

Forestry Products Industry (*see also* Booming grounds; Logs; Pulp and Paper Industry)

- 1:195-196 (log towing & handling; log booming grounds; piledriving; sawmills; mainly on river North Arm)
- :201, 329-330, 332-338 (applications to discharge effluents from)
- :212-213 (types of waste products from)
- :213 (deadheads as navigation hazard)
- :251(372); 2:IBO:(329) (contributing to air pollution)
- :IBO:(373) (hydrological considerations)
- : (455); 2:IBO:(321); 3:IBO:(380); 4:IBO:(306); 5:IBO:(271) (land capability classification)
- 2:132 (railway construction re development of)
- :144 (extent, accessibility & nature of forest resource)
- :144 (company timber holdings)
- :145 (streamside vegetation removal consequences)
- :149, 150 (wood composition; density; decomposition processes; products; toxicity)
- :166 (effects of particulate sulphur & organic acid emissions)
- :167; 5:IBO:(273) (logging, sawmilling & pulp pollutants)
- :168 (emission statistics for Squamish area forest industry)
- :IBO:(266); 3:IBO:(319) (harvesting)
- : (325, 383) (landscape description & inventories)
- : (330) (B.C. water quality protection guidelines)
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- 3:164 (effluent composition; toxicity & products of sawmill operations)
- :164 (effects of)
- :164; 3:251-252; 4:138 (location)
- :251-252 (discharger's identification numbers; amounts; effluent quality; comments with respect to river & estuarine pollution sources)
- :IBO:(321) (wood sedimentation components & properties)
- : (374) (wildlife implications)
- 4:xiv, 8, 9 (historical importance)



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   :(415); 2:IBO:(295); 3:IBO:(348) (B.C. use of fish for animal food)  
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   :(415); 2:IBO:(295); 3:IBO:(348) (grey cod tagging in Strait of Georgia)  
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   :(353) (population dynamics of western Canadian petrale sole (*Eopsetta jordani*))

## Forrester, E.A.M.

- 1:IBO:(347) (lower Fraser River flood plain study)  
 4:IBO:(307) (central Vancouver Island urban development)

## Forward, C.N.

- 1: 4(460) (map of Fraser River delta study area)  
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- 6:IBO:(282) (western hemlock & ambilis fir decay in Kitimat region)

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## Fox

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- Fraser River Estuary Arms and Channels (*see also* Fraser River system; *also* Annacis Channel; Annieville Channel; Cannery Channel; Canoe Pass; Ladner Reach; Middle Arm; Morey Channel; North Arm; Sea Reach; South Arm; Steveston Channel; *also* Dredging; Dykes; Flats, tidal; Runoff; Salt wedge; Sediments; *also* similar cognate headings)  
1: 4, 11 (maps showing)  
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- rib (*see Plantago lanceolata*)
- rye (*see Elymus ambiguus*; *E. condensatus*)
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- velvet (*see Holcus lanatus*)
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- vernal whitelaw (*see Draba verna*)
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- wheat (*see Agrophyon canium*)
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- wild rye (*see Elymus vancouverensis*)
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## Grass, A.L.

- 1:IBO:(400) (some B.C. land & freshwater Mollusca)

## Grass and Forb Community

- 1:129-131, 135 (of estuary area; list of other vegetation species)
- :129-131, 135; 2: xx (most abundant species)
- :130 (map of major areas)
- :135 (of dykes & jetties)
- 2:104, 106 (location)

Grasses (Note: Words ending in "grass" are indexed under the full name, e.g. Bluegrass; Lyme-grass; Saltgrass) (*see also* Grass for vernacular names; Gramineae)

- 1:130 (map showing major Fraser River estuarial area of)
- :280-287 (species list including)
- :320 (food of mice)
- :323 (food of bears)
- :IBO:(430-438) (bibliography including)
- 2:104, 106 (species; habitats)
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- 4:211 (in species list)

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- : 53 (transported by main river is deposited in riverbed between Agassiz & Mission)
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- : (357) (re Port Mann Bridge)
- : (362); 2:IBO:(257) (imbrication)
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- : (314) (Prince Rupert sampling)
- 4: 21 (Cowichan Valley distribution & regulations re)
- :IBO:(270); 5:IBO:(229) (Strait of Georgia)
- 5: 12, 13, 118 (extent, location, usage & value of Nanaimo deposits)
- :119 (removal regulations)
- 6: 14, 17 (economic importance)
- : 12, 13, 14, 15, 17 (regional distribution, sedimentary associations, specific sites, size, origin & composition of deposits)
- : 18 (removal permits re holders, displacements & sites)
- :IBO:(255) (Kitimat resources)

## Gray, A.V.

- 5:IBO:(273) (economic analysis of Nanaimo)
- : (278) (patterns of living in Nanaimo Regional District)

## Gray, F.W.

- 5:IBO:(228) (Canadian coal mining & geology)

## Gray, J.

- 1:IBO:(460) (character & pervasiveness of transport competition in movement of commodities from Greater Vancouver origins to B.C. destinations)

## Greases

- 1: 55, 56 (levels in estuary waters)

## Greater Britain Emigration Commission

- 5:IBO:(273) (survey of Cowichan & Nanaimo districts)

Great Hedge Nettle (*see Stachys mexicana*)Great Sculpin (*see Myoxocephalus polyacanthocephalus*)

## Greater Vancouver Real Estate Board

- 1:IBO:(460) (recent annual real estate trends)

## Greater Vancouver Regional District (reports, etc.)

- 1: 8 (source of information)
- :184(461); 2:IBO:(324) (population forecast)
- :186(461) (housing issue)
- :192, 193(461) (present & future industrial & economic development)
- :234(461) (map of proposed future industrial development areas of Fraser River delta)
- :235(461) (areas cited for proposed recreational development of delta)
- :IBO:(348) (annual report for 1972-1973)
- : (348) (nature of regional government)
- : (355) (librarian source of out-of-print & contract publications)
- : (373) (floodplain & floodproofing in lower Fraser Valley)
- : (461) (official regional plan booklet)
- : (487) (references to four maps)
- 2:IBO:(323) (report on livability)

## Greater Vancouver Sewerage and Drainage District

- 1: 92(401) (invertebrate fauna in vicinity of Iona Island sewage outfall)
- :147(432) (marine algae near outfall)
- :202, 207(477) (long range projects for Vancouver domestic organic waste treatment & disposal re marine pollution)
- :IBO:(477) (sewage treatment plant design & data)

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- eared (*see Podiceps nigricollis*)
- horned (*see Podiceps auritus*)
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- red-neck (*see Podiceps grisegena*)
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- 1:327 (aerial census of delta, 1966-1974)

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- Greenius, A.W.  
 1:IBO:(432); 3:102(366); 4:IBO:(297) (general status of B.C. seaweed industry)
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- Greenling, whitespotted (*see* Hexagrammos stelleri)
- Greenlings (general)  
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- Greenstripe Rockfish (*see* Sebastes elongatus)
- Green-winged Teal (*see* Anas carolinensis)
- Greenwood, W.H.  
 1:IBO:(449) (report of sea lion investigation)
- Greer, B.A.  
 5:140(280) (biological oxygen demand determinations)
- Greer, D.M.  
 5:IBO:(273) (re Nanaimo regional planning)
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- Griffith, L.M.  
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- Grill, E.V.  
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 : 84(400) (invertebrates on cemented sandstone in channels)
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 6:204 (in species list)
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- Groundsel (*see* Senecio vulgaris)
- Grouse  
 blue (*see* Dendragapus obscurus)  
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- Grunt Sculpin (*see* Rhamphocottus richardsoni)
- Grus canadensis* (sandhill crane)  
 1:301 (habitat; food; etc.)  
 3:xxiv (nests on estuary)  
 :119 (nesting habitat)  
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- Guiguet, C.J.  
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 3:117(372) (general wildlife information)  
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- Gulf Islands  
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- Sabine's (*see Xema sabini*)
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- :IBO:(443) (census)
- 5:107 (seasonal estuarine abundance & dynamics; peak abundance periods; concentration locations; feeding areas; species sighted)

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- 2:218; 3:243; 4:224 (in species list)
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- 1:IBO:(428) (status of Pacific Ocean perch stocks off B.C., Washington & Oregon)

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- 1:140, 141 (vegetation, soil)

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Gunter, G.

- 3:IBO:(389) (oysters & sulphite waste liquor)

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- 4: 71(287) (re insects)

Guthrie, J.

- 2:IBO:(331) (effects of Kraft mill effluent on Pacific oyster (*Crassostrea gigas*))

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- 3:113 (successional forest component)
- :229; 6:208 (in species list)

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- 1:261; 3:219 (in species list)

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- 4:187 (in species list)

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- 2:207; 6:207 (in species list)

*Habenaria orbiculata* (large round-leaved orchid)

- 6:207 (in species list)

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- 3:229; 6:207 (in species list)

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- 6:101 (community position; species associations; abundance)

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- 1:236 (map showing estuary areas sensitive for fish & wildlife conservation)
- :293-318 (of estuary birds)
- :319-323; 2:IBO:(318) (of estuary mammals)
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- 5:IBO:(228) (petrography of Canada in relation deposition environmnet)

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- 1:IBO:(422); 3: 87, 93(357) (time & extent of herring spawning along B.C. coast)
- 2: 93(300) (closure of herring season in southern B.C.)

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- 1:IBO:(440); 2:IBO:(311) (Vancouver occurrence)
- : (440); 2:IBO:(311) (nesting habitat)
- 2:212; 3:237; 4:218; 5:187 (in species list)
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- 5:106 (seasonal estuarine inhabitant)

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- 1:IBO:(401); 2:IBO:(285) (of B.C. waters)

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- 3:IBO:(369) (wave measurements from the drilling rig SEDCO-135F)

Haggen, E.

- 1:IBO:(369) (oil exploration near Vancouver, in the Fraser Valley & in Fraser delta)

Haig-Brown, R.

- 1:IBO:(416) (the Pacific salmon)

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Hairy Cat's Ear (*see Hypochaeris radicata*)

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- 1:299; 2:122, 123; 3:121 (food of; etc.)
- :299; 2:122, 123; 3:121; 6:107 (habitat)
- :328 (1970 raptor census of delta by areas)
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- :122, 123; 3:121 (numbers)
- :211; 3:237; 4:217; 5:186; 6:213 (in species list)
- :IBO:(315); 3:IBO:(323) (information source)
- 3:xxv, 121 (nest in tall trees along river & estuary)
- 4:122 (season of occurrence; estuarine locations)
- :122; 5:109 (nesting habitat)



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- : 60 (depth & navigation method)

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- 2: 75, 148 (in booming grounds)
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- 2:189; 3:203; 4:195 (in species list)

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- 1:IBO:(447) (list of parasites from sea mammals from west coast of North America)

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- 1:IBO:(345); 2:IBO:(246) (brief)

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- 2:151(333) (effects of pulp mill wastes on the receiving environment)
- 3:155(391) (environmental effects of pulp mill wastes)
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## Marine Sciences Directorate

- 1: 8 (source of information)
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- 1:190 (possible development in Boundary Bay)
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 6: 94 (dominance; community position)

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## Puffin

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*Pugettia* (kelp crabs)

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   :268; 3:208 (in species list)  
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## Pugh, W.G.

- 1:116, 124(423) (Boundary Bay fish resources)

## Pugh, W.L.

- 6:123(277) (Kitimat Harbour — re design, construction & facilities)

*Pullenia salisburyi*

- 1:260 (in species list)

Pulp and Paper Mills (principally Kraft pulp mills)  
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- 1:108 (*see first reference on page 481 re effect of tree bark in effluent on development of salmon eggs*)  
   :108, 200-201(483) (effects of toxic chemicals in effluents on young salmon)  
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   :334, 336, 337 (effluent permits & requirements)  
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- 3: xx (channel margins; delta front & ocean basin types & variations)
- : 13 (of Skeena River channels)
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- : 153 (condition in fish production plant outfall areas)
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- : (310) (Skeena estuary transects)
- : (331); 4:IBO:(317); 5:IBO:(283); 6:IBO:(265, 287) (accumulation)
- 4: 25, 26 (origin in Chemainus salt marsh & tidal flats)
- : 27(268) (regional grain size variation in Cowichan Bay & Satellite Channel)
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- : 143 (riverine load; processes & effects re watershed logging)
- : IBO:(231, 254) (marine decomposition)
- 6: 12, 13, 14, 15 (origins; age; significance)
- : 16 (grain size analysis for Kitimat delta)
- : 41 (re pulp mill wastes)
- : 71(255, 263, 280) (re Kitimat Arm)

## Sedola, G.A.

- 5: 3(224) (history of Nanaimo & its environs)
- : IBO:(274) (past Nanaimo scenes)

*Sedum roseum* (red stonecrop)

- 3:114 (nitrogen tolerance; salt tolerance; habitat)
- : 232 (in species list)

*Sedum spathulifolium* (broad-leaved stonecrop)

- 4:214 (in species list)

## Seed, A.

- 1:IBO:(451) (sea otter in northeastern Pacific waters)

## Seeds

- 1:153, 160, 161 (of *Scirpus* as food of birds)
- : 293, 300, 301, 305, 308-317 (as food of birds)
- : 320-322 (as food of mammals)

## Seelig, M.V.

- 1:IBO:(469) (time present & time past: proposal for area conservation in Vancouver)

## Seismicity

- 1: 16 (epicentres in Strait of Georgia region)
- : 17 (as suggested cause of Lulu Island swales)
- : IBO:(364); 2:IBO:(259); 3:IBO:(311) (Canadian research)
- : (369); 2:IBO:(262); 3:IBO:(314) (earthquake related phenomena)
- 3:IBO:(312, 314) (earthquake effects)
- 6:IBO:(256) (refraction survey)

*Seiurus aurocapillus* (ovenbird)

- 6:216 (in species list)

*Seiurus noveboracensis* (northern waterthrush)

- 3:240; 4:222; 6:216 (in species list)

## Seki, H.

- 1:IBO:(479) (importance & general implications of organic matter in aquatic environments)
- 5: 42(245) (productivity studies)
- : 47, 93(245, 265) (Nanaimo estuary nutrient sources)
- : 92(265) (estuarine phytoplankton & primary productivity)
- : IBO:(231, 254) (marine sediment decomposition studies)
- : (254) (contribution of small river allochthonous bacteria & organic materials to a semi-enclosed sea)

*Selaginella oregona*

- 3:226 (in species list)

*Selaginopsis* sp.

- 2:186 (in species list)

*Selasphorus rufus* (rufous hummingbird)

- 2:213; 3:239; 4:220; 5:189; 6:214 (in species list)
- 6:108 (seasonal & peak abundance)

## Selenium Compound

- 1:212 (as toxic constituent in effluents from some industries)

## Sellmer, H.W.

- 3:IBO:(313) (geology & petrogenesis of the Serb Creek intrusive complex near Smithers, B.C.)

## Selwyn, A.R.C.

- 4: 13(271) (initial geological work in southeast Vancouver Island)
- 5:IBO:(231) (B.C. journal & report)

Semaestomae (*see Cyanea*)

## Semakula, S.N.

- 1:113(425) (biology of Fraser River white sturgeon)
- : 122(425) (exploitation of river white sturgeon)

## Semiahoo Bay

- 1:132 (eelgrass community)
- : 156 (aerial census of black brant)

*Senecio sylvaticus* (ragwort)

- 6:202 (in species list)

*Senecio triangularis* (giant ragwort)

- 3:232; 6:202 (in species list)

*Senecio vulgaris* (groundsel)

- 1:286; 6:202 (in species list)

*Sergestes similis* (shrimp)

- 3:208 (in species list)

## Serpentine Fen

- 1:139 (waterfowl management)
- : 155 (young Canada geese reared annually)
- : 179 (use by schools for wildlife study)
- : 189 (map showing area as wildfowl refuge)



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- : 14 (tidal flats)
- : 14, 81 (as source of Boundary Bay sediments)
- : 86 (cause of lack of crabs in Boundary Bay)
- :116 (no major salmon runs in)
- :117 (some chum salmon runs in)
- :125 (commercial trout farming unsuccessful because of expense of water purification)
- :140 (eelgrass in outwash channel)
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- :IBO:(374) (flooding)
- :(462) (problems; proposals)
- :(463) (conservation efforts)

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- 2: 77 (*S. vermicularis* abundance & west delta habitat)
- :188; 4:198 (*S. vermicularis* (in species list))

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- 3:201 (in species list)

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- 2:186 (in species list)

## Servizi, J.A.

- 1: 3(378) (map of Fraser River drainage system)
- : 82, 126(378, 405, 430) (water quality & bottom-dwelling organisms of Fraser River system)
- :108(425) (toxicity of Kraft pulpmill wastes & chlorinated catechols to sockeye)
- :108(425); 2:IBO:(301, 335); 3:IBO:(392) (effects of decaying bark on incubating sockeye eggs)
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- :108(425, 480) (effects of water quality & pollutants on migration, spawning & hatching of sockeye)
- :108(478); 3:IBO:(391) (toxicity of de-inking wastes containing salmon)
- :IBO:(421); 2:IBO:(298, 333); 3:IBO:(393) (toxicity of copper to sockeye & pink salmon during early freshwater life)
- :(481) (preliminary survey of toxicity of chlorinated sewage)
- :(481); 3:IBO:(393) (detoxification of Kraft pulpmill effluent by an aerated lagoon)
- 2:154(325) (Kraft pulpmill effluent toxicity reduction)
- :IBO:(301, 335) (toxicity & treatment of Kraft pulp bleach plant)
- :(301, 335); 3:IBO:(392) (toxicity of two chlorinated catechols, possible components of Kraft pulp mill bleach waste)
- 3:IBO:(392) (treatment & toxicity of Kraft pulp bleach waste)

*Setaria lutescens* (yellow bristle grass)

- 1:286 (in species list)

*Setophaga ruticilla* (American redstart)

- 3:240; 6:216 (in species list)

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- 1:xvii, 54-57, 59, 90, 97, 126, 205; 5:43 (re coliform bacteria counts)
- :201, 339-341 (permits for discharge of domestic effluents into waterways: effluent amounts; biological oxygen demand, total suspended solids; chemical residuals)
- :202-209(472) (management; reports on; treatment plants; nature of effluents; effects on algae, fish, shellfish & recreation facilities)
- :202-209, 213-215(472, 476); 4:IBO:(277, 317); 5:40, 41, 42, 63, 152 (disposal - Greater Vancouver; system growth; currents & tidal effects on; into river or sea; solid waste, as landfill; studies; recommendations; facilities installed; site requirements; methods; locations)
- :205, 206-209 (chlorination of, & dechlorination of chlorinated)
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- :IBO:(366) (Iona Island outfall)
- :(394, 479); 2:IBO:(333); 3:IBO:(391); 4:IBO:(314) (ecological effects of)
- :(472-480) (bibliography including)
- :(473); 2:IBO:(328); 3:IBO:(386) (trace metal contaminants)
- :(473); 2:IBO:(328); 3:145, 147, 148(386); 5:136, 137(280); 6:131, 137 (treatment - processes & problems; degree of; facilities; historic & current potential; procedures & efficiency)
- :(475); 2:IBO:(330); 3:IBO:(389) (as water pollutant)
- :(477, 480) (Vancouver statistics)
- 2:141, 143 (permissible daily discharges)
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- 3:145, 147, 148 (permissible daily discharges for Prince Rupert city & ferry terminal; fish processing plants, Terrace, Smithers, Hazelton, Granisle, Totem Marina, Skogland Hotsprings Hotel & Resort; & Winck Memorial; source & discharge locations; potential public health hazards)
- :148 (effects on resident flora & fauna)
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- :149 (possible future problems)
- :245-249; 3:255-257 (discharger's identification numbers; locations, amounts & comments with respect to river, estuarine & upstream pollution sources)
- :245-249; 3:255-257; 6:137 (effluent quality & characteristics)
- :IBO:(396) (Hazelton sewer installation)
- 4:146 (shellfish quality re)
- :146, 232-235; 5:136, 137 138 (pollution - faecal; regional sources of; levels in shellfish growing areas)
- :150; 5:152; 6:137, 166, 169 (environmental influences)
- :150; 5:IBO:(246, 282) (re oceanography)
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   : 43 (sampling stations)  
   :136, 137(280) (historic & current outfalls; jurisdiction; policy; survey; recommendations; rationale; service areas; physical, chemical & biological observations)  
   :136, 137(280); 6:137 (monitoring programs)  
   :152 (trends; studies; results; expected life)  
   :154 (effects on shellfish harvesting)  
 6:136 (original facilities & supporting rationale)  
   :137 (re Alcan & Eurocan)

## Sewell, W.R.D.

- 1:IBO:(374) (economic & institutional aspects of adjustment to floods in lower Fraser Valley)  
   :(374) (water management & floods in Fraser River basin)

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## Shady Island (formerly Steveston Island)

- 1: 83 (sparseness of marine life on shoals)  
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   :144-145 (formation from sand bar by material dredged from Cannery Channel; flora species & succession)

## Shand, J.A.

- 1: 70 (387) (internal waves in Strait of Georgia)

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- basking (*see Cetorhinus maximus*)  
 blue (*see Prionace glauca*)  
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 sixgill (*see Hexanchus griseus*)  
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Sharpfin Rockfish (*see Sebastes zacentrus*)Sharpnosed Sculpin (*see Clinocottus acuticeps*)

## Shaw, L.

- 4:158(316); 5:134(282); 6:132(286) (legislation controlling aspects of environmental pollution)

## Sheean, S.

- 3:IBO:(319) (chemical & physical limnological observations for Babine & Great Central Lake)

## Sheep

- mountain (*see Ovis sp.*)  
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 1:183 (acreage used for farm production)

Sheep Sorrel (*see Rumex acetosella*)

## Sheldon, R.W.

- 5: 42(245) (productivity studies)  
   : 92(265) (estuarine phytoplankton & primary production studies)  
   :IBO:(231, 254) (seasonal variations in food availability for coastal benthos)

Shellfish (*see also* Bivalvia; Clam; Clams; Crab; Crabs; Gastropoda; Limpets; Mollusca; *Mytilus*; *Nassarius*; Oyster; Oysters; *Purpura*; Scallop; Shrimp; Shrimps; etc.)

- 1:xvii, 97, 208 (coliform bacteria pollution causing ban on commercial fishing off Point Grey & Boundary Bay areas)  
   : 98 (map of major beds & fisheries in estuary areas)  
   : 99 (possible resource of delta tidal flats)  
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   :208, 209 (concentration of pathogenic organisms by)  
   :264-265, 268, 271, 274 (in species list)

## Shepard, F.P.

- 1: 14, 15(364) (geological evolution & sedimentation of Fraser River delta)  
   : 28(364) (annual advance rate of delta front)  
   :IBO:(366); 2:IBO:(259) (sedimentation of delta)

## Shepard, M.G.

- 1:167(441) (status of birds in Fraser River delta)  
   :167(441) (raptorial birds of delta)  
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   :317, 318(441) (birds of delta)  
   :IBO:(441) (checklist of Vancouver birds)  
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## Shepard, M.P.

- 1: 99(406) (B.C. mollusc fisheries)  
   :100(406) (B.C. shrimp fisheries)  
   :105(409) (chinook salmon fishery of Fraser River & delta)  
   :106(409) (coho salmon spawning in river)  
   :107(409) (timing & pattern of mature sockeye salmon migration into & within river)  
   :119(425) (review of sockeye fishery & canning on river)  
   :120(425) (pink salmon exploitation in river)  
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   : 93(290, 301); 4: 98, 99(291) (B.C. commercial fisheries)  
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   :201(290, 301) (list of estuary fish species)  
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   : 83(344) (chinook abundance & spawning locations)  
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   : 90(344) (peak catch seasons for pink, chum, coho & chinook salmon)  
   : 91(359) (Butterworth-Warrior Rocks trawl fishery)  
   : 92(359) (B.C. halibut fishery)  
   :IBO:(359) (abundance, distribution & commercial application of the fishery resources of Canada's west coast)

## Shepherd, B.G.

- 5: 87(260) (angler harvests & other recreational uses of Nanaimo watershed)

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- Shepherd's purse (*see Capsella bursa-pastoris*)
- Sheppard, A.T.  
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:(393) (re Department of Environment projects in Prince Rupert/Skeena area)
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2:IBO:(252); 3:IBO:(303) (annotated bibliography re effects of suspended & deposited solids)
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- Shiner  
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- 5: 16, 17 (habitats with respect to soil types)
- 6: 92, 94, 96, 98, 99, 100, 101, 102 (re location, classification, boundaries, composition & environmental influences)

*Sialia currucoides* (mountain bluebird)

- 1:310 (habitat; food; etc.)
- 2:214, 3:240; 4:221; 5:190; 6:215 (in species list)

*Sialia mexicana* (western bluebird)

- 4:221; 5:190 (in species list)

Siberian Miner's Lettuce (see *Claytonia sibirica*)

## Sibert, J.

- 1:IBO:(394) (food web of Squamish River estuary)
- : (425); 2:IBO:(302); 3:IBO:(360) (model of juvenile pink salmon growth in the estuary)
- 2:128(279) (estuary food web)
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- : 78(260) (local residency of juvenile salmon)
- :IBO:(245) (Departure Bay water properties)

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- 4: 17 (composition, location & relationship to Vancouver Group)

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- 1:286; 2:208 (in species list)
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- 4:187 (in species list)

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- :184(352) (history of Vancouver re settlement of delta)

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- 1: 13 (grain size)
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- : 69(267) (parasitic & viral plant diseases)
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- 1: 90 (significant level in Sturgeon Bank macrofauna)
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## Simeon, J.

- 4:IBO:(283) (Cowichan Valley natural history)

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- 6:187 (in species list)

## Simons, H.A. International Limited

- 5: 42(245) (re monitoring Northumberland Channel water quality)
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- 3:IBO:(303) (B.C. archaeological investigations in the Hecate Strait - Milbanke Sound area)

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- : (396) (invertebrate study)
- : (402) (sediment-faunule relationships; benthic ecology; species composition; benthic intertidal zonation)
- : (406, 438) (ecology)
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- : (431) (natural history)
- : (437) (estuary plants)
- : (454) (birds)
- : (487, 488) (maps)
- 4:180:(311) (baseline study)

Sturgeon Poacher (*see* *Agonus acipenserinus*)*Sturnella neglecta* (western meadowlark)

- 1:313 (habitat; food; etc.)
- 2:215; 4:222; 5:190 (in species list)

*Sturnus vulgaris* (common starling)

- 1:311 (habitat; food; etc.)
- :180:(444) (nesting sites)
- 2:123 (Squamish sightings)
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- 5:109 (abundance; feeding areas; over-wintering locations)

*Stylaria* sp. (oligochaete, unspecified)

- 4:185 (in species list)

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- 3:202 (in species list)

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- 2: 75 (inhabits Sunset Marina)
- : 75, 148 (deep water abundance)
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- 1: 187 (in species list)

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- 3: 115 (upper intertidal flora)
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- 2: 109 (subdivision of mountain hemlock zone)
- 5: 101 (location; characteristic species; zonal productivity; elevation)

## Subalpine Parkland Higher Subzone

- 2: 109 (mountain hemlock zone subdivision)

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- 2: 78 (Pisces IV expedition)

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- 5: IBO: (255) (Canadian Pacific)

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- : 211, 212, 213 (sulphides as toxic effluent from tanneries, laundering establishments & petrochemical industries)
- : 214 (hydrogen sulphide, iron & manganese sulphides in solid waste disposal areas)
- : 228, 229, 230 (hydrogen sulphide in bottom sediments, from decay of benthos)
- : 229 (nematodes & some oligochaetes able to survive in presence of hydrogen sulphide)
- : 246-251 (sources & amounts from industrial emissions, re atmospheric pollution)
- : 255-257 (routine determination localities for sulphate in river basin waters; re water quality)
- 2: 147, 149, 153 (hydrogen sulphide release from sediments & accumulation under anaerobic conditions)
- : 162 (sulfates in chlor-alkali plant effluents)
- : 167 (amounts discharged)
- : 175 (hydrogen sulphide release re dredging)
- 3: IBO: (297) (Vancouver handling of)
- : (395) (re Kraft pulp mill effluents)

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- 1: 52 (upper limit of tidal effect on delta)

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- 3: 87(361) (Pacific herring in the Skeena area)

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- : 42-43 (seasonal data)
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- : 246-251 (radiation re photochemical oxidation of atmospheric pollutants)

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- 2: 205 (in species list)
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- 1: 11, 12 (geology)
- : 33-35 (climatological stations)
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- : 191 (beaches)
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- 2: IBO: (260) (western cordillera copper & molybdenum deposits)
- : (261) (Britannia, B.C.)
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- 4: 17 (composition, location, origin & relationship to Vancouver Group)

## Sutton, W.J.

- 4: IBO: (271) (Vancouver Island geology & mining)

## Suzuki, B.M.

- 3: IBO: (348) (B.C. inventory of groundfish market samples)

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- 1: 171(452) (general status of mammals in Fraser River delta)

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 :153(367) (delta foreshore usage by wildlife, with map on page 154)  
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 6:117(279) (possible public marina sites)  
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 : (279) (feasibility study re MK Bay marina)
- Swan Wooster Engineering Company Limited and James and Moore  
 3:IBO:(304) (Norport, Prince Rupert)
- Swann, L.G.  
 1:IBO:(426) (a century of B.C. fishing)
- Swanson, H.S.  
 1:IBO:(374) (flow analysis of water allocation in a river system re effect on estuarine ecology)
- Swarth, H.S.  
 1:IBO:(440) (distributional list of B.C. birds)  
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*Synedra tabulata*

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- 1:115 (use of estuarial zone for migration salinity transition)  
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- Wilson, R.R.  
 5:IBO:(232) (The Granby Consolidated Mining, Smelting & Power Company's colliery at Cassidy, Vancouver Island)
- Wilson, W.A.  
 3:IBO:(364) (survey of B.C. commercial fishermen's incomes)  
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